From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 22 March 2000 (22.03.00)	
International application No. PCT/EP99/05326	**Applicant's or agent's file reference** DB 757 PCT
International filing date (day/month/year) 16 July 1999 (16.07.99)	**Priority date** (day/month/year) 21 July 1998 (21.07.98)
Applicant DE BENEDITTIS, Rossella et al	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International Preliminary Examining Authority on:

   11 February 2000 (11.02.00)

   [ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

   [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer A. Karkachi
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

3181259

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

GIUSTINI, Delio
Siemens Information and
Communication Networks S.p.A.
Cascina Castelletto
I-20019 Settimo Milanese
ITALIE

Date of mailing (day/month/year)
22 March 2000 (22.03.00)

Applicant's or agent's file reference
DB 757 PCT

IMPORTANT NOTIFICATION

International application No.
PCT/EP99/05326

International filing date (day/month/year)
16 July 1999 (16.07.99)

1. The following indications appeared on record concerning:

[ ] the applicant [ ] the inventor [X] the agent [ ] the common representative

Name and Address
GIUSTINI, Delio
Italtel Spa
Cascina Castelletto
I-20019 Settimo Milanese
Italy

State of Nationality:
State of Residence:
Telephone No.: 39 02 43887701
Facsimile No.: 39 02 43887703
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [X] the address [ ] the nationality [ ] the residence

Name and Address
GIUSTINI, Delio
Siemens Information and
Communication Networks S.p.A.
Cascina Castelletto
I-20019 Settimo Milanese
Italy

State of Nationality:
State of Residence:
Telephone No.: 39 02 43887701
Facsimile No.: 39 02 43887703
Teleprinter No.:

3. Further observations, if necessary:
The agent's new address on the Demand has been considered as a change under Rule 92bis. In case of disagreement, the International Bureau should be notified immediately.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[X] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
A. Karkachi

Telephone No.: (41-22) 338.83.38

TENT COOPERATION TRE Y

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

GIUSTINI, Delio
Siemens Information and
Communication Networks S.p.A.
Cascina Castelletto
I-20019 Settimo Milanese
ITALIE

Date of mailing (day/month/year)
06 November 2000 (06.11.00)

Applicant's or agent's file reference
DB 757 PCT

IMPORTANT NOTIFICATION

International application No.
PCT/EP99/05326

International filing date (day/month/year)
16 July 1999 (16.07.99)

1. The following indications appeared on record concerning:
☐ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

State of Nationality | State of Residence

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:
☒ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address
SIEMENS INFORMATION AND
COMMUNICATION NETWORKS S.P.A.
Viale Piero e Alberto Pirelli, 10
I-20126 Milano
Italy

State of Nationality: IT | State of Residence: IT

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:
Additional applicant for all designated States except US.

4. A copy of this notification has been sent to:
☒ the receiving Office
☐ the International Searching Authority
☒ the International Preliminary Examining Authority
☐ the designated Offices concerned
☒ the elected Offices concerned
☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
C. Cupello

Telephone No.: (41-22) 338.83.38

TENT COOPERATION TRE Y

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

To:

GIUSTINI, Delio
Siemens Information and
Communication Networks S.p.A.
Cascina Castelletto
I-20019 Settimo Milanese
ITALIE

Date of mailing (day/month/year)
12 January 2001 (12.01.01)

Applicant's or agent's file reference
DB 757 PCT

IMPORTANT NOTIFICATION

International application No.
PCT/EP99/05326

International filing date (day/month/year)
16 July 1999 (16.07.99)

1. The following indications appeared on record concerning:

[X] the applicant [ ] the inventor [ ] the agent [ ] the common representative

Name and Address
ITALTEL SPA
Via A. di Tocqueville, 13
I-20154 Milano
Italy

State of Nationality: IT
State of Residence: IT
Telephone No.:
Facsimile No.:
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

[ ] the person [ ] the name [ ] the address [ ] the nationality [ ] the residence

Name and Address

State of Nationality:
State of Residence:
Telephone No.:
Facsimile No.:
Teleprinter No.:

3. Further observations, if necessary:
The above applicant has been deleted from the records.

4. A copy of this notification has been sent to:

[X] the receiving Office
[ ] the International Searching Authority
[ ] the International Preliminary Examining Authority
[ ] the designated Offices concerned
[X] the elected Offices concerned
[ ] other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer
G. Bähr

Telephone No.: (41-22) 338.83.38

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No. PCT/EP 99 / 05326

International Filing Date 16 JUL 1999 16.07.1999

EUROPEAN PATENT OFFICE
PCT INTERNATIONAL APPLICATION

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* DB 757 PCT

Box No. I TITLE OF INVENTION

Method and device for the antenna selection in a digital telecommunication system.

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

ITALTEL SPA
Via A. di Tocqueville, 13
20154 MILANO
ITALY

☐ This person is also inventor.

Telephone No. +39.02.43887701

Facsimile No. +39.02.43887703

Teleprinter No. 314840 SITELE I

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

DE BENEDITTIS ROSSELLA
Via delle Margherite, 9
20020 Barbaiana di Lainate MI
Italy

This person is:
☐ applicant only
☒ applicant and inventor
☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is,country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

GIUSTINI DELIO
italtel spa
Cascina Castelletto
20019 SETTIMO MILANESE
Italy

Telephone No. +39.02.43887701

Facsimile No. +39.02.43887703

Teleprinter No. 314840 SITELE I

☐ **Adress for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet should not be included in the request.

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

ROSINA GIANCARLO
Cascina Legoratta
20018 Sedriano MI
Italy

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BETTI ALESSANDRO
Via Rosetani, 24
62100 MACERATA
Italy

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

SALTINI GIORGIO
Via Dario Niccodemi, 1
20156 MILANO
Italy

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: IT

State *(that is, country)* of residence: IT

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☒ the United States of America only
- ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality:

State *(that is, country)* of residence:

This person is applicant for the purposes of:
- ☐ all designated States
- ☐ all designated States except the United States of America
- ☐ the United States of America only
- ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on another continuation sheet.

Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

- ☐ AP **ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SZ** Swaziland, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☐ EA **Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ EP **European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA **OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Côte d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line)*:

- ☐ AL Albania .....
- ☐ AM Armenia .....
- ☐ AT Austria .....
- ☐ AU Australia .....
- ☐ AZ Azerbaijan
- ☐ BA Bosnia and Herzegovina .....
- ☐ BB Barbados
- ☐ BG Bulgaria .....
- ☐ BR Brazil .....
- ☐ BY Belarus .....
- ☒ CA Canada
- ☐ CH and LI Switzerland and Liechtenstein
- ☐ CN China .....
- ☐ CU Cuba .....
- ☐ CZ Czech Republic .....
- ☐ DE Germany .....
- ☐ DK Denmark .....
- ☐ EE Estonia .....
- ☐ ES Spain .....
- ☐ FI Finland .....
- ☐ GB United Kingdom
- ☐ GD Grenada
- ☐ GE Georgia .....
- ☐ GH Ghana .....
- ☐ GM Gambia
- ☐ HR Croatia .....
- ☐ HU Hungary .....
- ☐ ID Indonesia
- ☐ IL Israel .....
- ☐ IN India .....
- ☐ IS Iceland
- ☐ JP Japan .....
- ☐ KE Kenya .....
- ☐ KG Kyrgyzstan .....
- ☐ KP Democratic People's Republic of Korea .....
- ☐ KR Republic of Korea .....
- ☐ KZ Kazakhstan .....
- ☐ LC Saint Lucia
- ☐ LK Sri Lanka
- ☐ LR Liberia
- ☐ LS Lesotho .....
- ☐ LT Lithuania
- ☐ LU Luxembourg
- ☐ LV Latvia
- ☐ MD Republic of Moldova .....
- ☐ MG Madagascar .....
- ☐ MK The former Yugoslav Republic of Macedonia .....
- ☐ MN Mongolia
- ☐ MW Malawi .....
- ☐ MX Mexico .....
- ☐ NO Norway
- ☐ NZ New Zealand .....
- ☐ PL Poland .....
- ☐ PT Portugal .....
- ☐ RO Romania
- ☐ RU Russian Federation .....
- ☐ SD Sudan
- ☐ SE Sweden
- ☐ SG Singapore
- ☐ SI Slovenia .....
- ☐ SK Slovakia .....
- ☐ SL Sierra Leone
- ☐ TJ Tajikistan .....
- ☐ TM Turkmenistan .....
- ☐ TR Turkey .....
- ☐ TT Trinidad and Tobago .....
- ☐ UA Ukraine .....
- ☐ UG Uganda .....
- ☒ US United States of America .....
- ☐ UZ Uzbekistan .....
- ☐ VN Viet Nam .....
- ☐ YU Yugoslavia .....
- ☐ ZW Zimbabwe .....

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

- ☐ .....
- ☐ .....
- ☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 21 JUL 1998 (21.07.1998)	MI98A 001674	ITALY		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA /

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country *(or regional Office)*

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following **number of sheets:**

request	: 04
description (excluding sequence listing part)	: 10
claims	: 03
abstract	: 01
drawings	: 03
sequence listing part of description	:
Total number of sheets	: 21

This international application is **accompanied by** the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney; reference number, if any: 25928
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☒ translation of international application into (language): ENGLISH
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract: 4

Language of filing of the international application: ENGLISH

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Milan, 16 July 1999

GIUSTINI DELIO
G.A. 25928

For receiving Office use only

1. Date of actual receipt of the purported international application: 16 JUL 1999 (16.07.1999)
2. Drawings: ☒ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA /
6. ☐ Transmittal of search copy delayed until search fee is paid.

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PATENT COOPERATION TREA

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
DB 757 PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 99/ 05326	16/07/1999	21/07/1998
Applicant		
ITALTEL SPA ET AL.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language,** the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of Invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 4

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/05326

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/08 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 08089 A (NOKIA TELECOMMUNICATIONS OY ;MOGENSEN PREBEN (DK)) 14 March 1996 (1996-03-14) page 3, line 11 -page 4, line 4 page 5, line 1 - line 3 page 5, line 21 - line 27 page 6, line 14 - line 25 ---	1,10
A	US 5 459 873 A (MOORE MORRIS ET AL) 17 October 1995 (1995-10-17) column 2, line 24 - line 26 column 2, line 36 - line 39 column 3, line 44 - line 56 column 4, line 12 - line 21 claims 1-3 claim 6 figure 4 --- -/--	1,10

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 November 1999	18/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Gkeli, M

2

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	SAFAVI S ET AL: "PREDETECTION QUALITY DIVERSITY SCHEME FOR DECT OUTDOOR APPLICATIONS" ELECTRONICS LETTERS, vol. 32, no. 11, 23 May 1996 (1996-05-23), pages 966-968, XP000599112 ISSN: 0013-5194 page 967, left-hand column, line 1 - line 5 page 967, left-hand column, line 27 - line 41 page 967, right-hand column, line 11 -page 968, left-hand column, line 4 figure 1	1,10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 99/05326

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9608089 A	14-03-1996	AU 3347495 A	27-03-1996
US 5459873 A	17-10-1995	NONE	

PATENT COOPERATION TREATY

PCT

REC'D 24 OCT 2000

WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

3

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
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International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP99/05326	16/07/1999	21/07/1998
International Patent Classification (IPC) or national classification and IPC H04B7/08		
Applicant ITALTEL SPA ET AL.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 13 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
11/02/2000	20. 10. 00
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Giglietto, M Telephone No. +49 89 2399 8214

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP99/05326

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-10	as received on	17/07/2000	with letter of	12/07/2000

Claims, No.:

1-10	as received on	17/07/2000	with letter of	12/07/2000

Drawings, sheets:

1/3-3/3	as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims 1-10
	No:	Claims
Inventive step (IS)	Yes:	Claims 1-10
	No:	Claims
Industrial applicability (IA)	Yes:	Claims 1-10
	No:	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Citations:

   D1: 'PREDETECTION QUALITY DIVERSITY SCHEME FOR DECT OUTDOOR APPLICATIONS' ELECTRONICS LETTERS, vol. 32, no. 11, 23 May 1996 (1996-05-23), pages 966-968, ISSN: 0013-5194

2. The application relates to a method for performing an antenna selection in a TDMA mobile radio system and particularly in a DECT system.

2.1 The closest prior-art is document D1 which shows a method for antenna selection in a DECT system comprising the steps of performing RSSI measurements during a preamble and of performing instantaneous power correlation measurements (R0 and R1). The drawback is that the measurement is limited to the preamble interval; further measurement on the data bits would cause errors on the received data.

3. Object of the present invention is to provide an improved method that overcomes the drawbacks of the above mentioned prior-art.

4. A method is proposed in claim 1 comprising inter-alia the steps of detecting an unsuccessful correlation operation on the preamble, performing a RSSI measurement on the antennas for a number K of measuring cycles, determining whether the power variability of each antenna during a time slot period is included in first range (stationary slot conditions) and verifying if the power variability among the different antennas is included in a second range.
   The proposed method improves the prior-art methods especially in the antenna selection of a sectorial array.

5. These features of independent claim 1 are not known from any of the available prior-art documents nor are they rendered obvious thereby:

D1: no power variation measurement is disclosed (see par. 2.1 above). No first and second ranges.

Claim 10 has been understood as relating to a device comprising means for performing the steps of the method of claim 1 (see section VIII).
Therefore, the subject-matter of claims 1 and 10 meets the requirements of Art. 33(2) and (3) PCT.

The dependent claims add further features to the independent claims and thus also relate to novel and inventive subject-matter.

Re Item VII
Certain defects in the international application

1. A document reflecting the prior art described on pages 2-5, is not identified in the description (Rule 5.1(a)(ii) PCT).

2. At page 5 of the description, the reference number XP.. of D1 should have been deleted since it is not public (for internal use at the EPO only).

Re Item VIII
Certain observations on the international application

1. Claim 10 should have been reworded to clarify that the claimed device is characterized in that it comprises means for performing the steps of the method of claim 1.

"Method and Device for the Antenna Selection in a Digital Telecommunication System"

Technical Field

The present invention relates to digital telecommunication systems according to Time Division Multiple Access (TDMA), and in particular, but not exclusively, relates to systems operating according the DECT standard (Digital Enhanced Cordless Telecommunications).

More precisely, the present invention relates to a method and a device for the selection of an antenna used in the fixed radio station of such system.

In the following description reference will be made in particular to a DECT system, without that this should be limited thereto. The invention can be generally applied in systems where the connection between two transceiver units (a radiomobile or portable unit or PP (Portable Part according to the DECT terminology) and a fixed radio station or RFP (Radio Fixed Part) is realized.

As already known, the DECT system includes a plurality of fixed radio stations distributed in a way to cover the interested areas and controlled by a centralised unit (CCFP, Central Control Fixed Part), and connected to a switching network which may be the public one of the private type (PABX), and of portable units linking up via radio with the fixed radio stations, and being able to communicate with each other and with others fixed users connected to the telephone network. The links may be of the voice type or they may enable the exchange of data occupying the equivalent of one or more voice "channels".

At first, an exemplary DECT network architecture is schematically illustrated in Fig. 1.

It comprises groupings of h (in the example of the figure h = 4) fixed radio stations RFP (Radio Fixed Part) preferably connected to coppers (in the example 3 coppers) set up by connection or dorsal lines L through drop/insert devices DI. Without departing from the scope of the present invention, it turns obviously out to be possible to connect in a star-shaped way each RFP to the CCFP eliminating the aforesaid connection lines, and therefore obviously also the Drop/Insert devices DI.

Each RFP can manage via radio a certain number of PPs, which generally are mobile.

The coppers end up at a TRAnScoder unit TRAS, and the latter is for example connected to the public network PSTN (Public Switching Telephone Network) through a Central Control Fixed Part (CCFP) associated to a switching network or a dedicaded switching module MEP.

Regarding the vocal signals, digital 64 Kbit/s channels typically set up the interface between the CCFP and the accessed network. To the CCFP unit a set of transcoders TRAS is associated providing for the conversion of the PCM codification (Pulse Code Modulation) on 8 bits used at the PSTN side into an ADPCM (Adaptive Differential Pulse Code Modulation) codification on four bits used at the DECT side. In this way two 32 Kbit/s channels can be mapped onto each 64 Kbit/s channel.

The 2,048 Mbit/s (bi-directional) connection link connecting the CCFP to the different RFPs supports therefore 48 voice channels plus a predetermined number of synchronisation and signalling channels.

The area covered by a fixed radio station or cell is generally rather reduced, arriving also to a radio coverage radius of tens or hundreds of metres. Typical applications of the personal telephony systems can be found in industrial plants where they may substitute the installation of a cabled network, in shopping centres or urban centres where they may advantageously substitute public telephone boxes and so on.

The telecommunication network for personal telephony is of the digital type. The radio access technology is of the type FDMA (Frequency Division Multiple Access) - TDMA (Time Division Multiple Access) - TDD (Time Division Duplex).

The system is of the TDD type as the transmission and reception direction are time divided. More precisely, as illustrated with reference to Fig. 2, the time frame interval of 10 milliseconds is divided into two halves: usually during the first 5 ms (i.e. in the first half frame) the fixed radio station transmits and the portables receive, and in the following 5 ms (i.e. in the second half frame) the contrary happens. Each half frame is set up by 12 time channels or time slots, hereafter for the sake of brevity also referred to as "slot", (from which it comes that DECT is a TDMA system, set up by 420 (or in some cases by 424) bits. The slots are transmitted or received using 10 (or more) different frequencies (from where it results that DECT is an FDMA system as well, which allows to provide to the system up to 120 (or more) radio channels (where a radio channel is identified by the pair (time slot + frequency).

The DECT multiframe is illustrated in Fig.3 and has a duration of 160 ms, so that it includes 16 frames of 10 msec each as described in Fig. 2

For further details on the DECT system please refer to the specifications established by the European Telecommunications Standards Institute, briefly ETSI (Ref. EN 300 175 specification).

In a DECT system the fixed radio station or RFP has an antenna system which may have different configurations:

- N antennas (with N equal to at least 2) for management in space diversity and/or polarisation of the received signal;
- a set of sectorial antennas, that is a system in which a plurality of antennas is connected to each RFP where every antenna of the set lightens just a portion (or sector) of the entire cell or of the RFP coverage area (usually trisection antennas are defined which implies therefore the use of antennas with a coverage angle of 120°);
- a set of phased antennas suitable to set up a radiation diagram with variable direction and gain.

Moreover the RFP includes a selection device or appliance among the antennas enabling the selection of the most suitable one that is that antenna which assures the better quality for the detected signal.

In fact the transmitted signal, especially in an urban environment, may be affected by the so-called fading phenomenon constituted by amplitude and phase variations of the electromagnetic field or of the power of the detected signal due to changeable propagation conditions. Because of such a phenomenon, in a predetermined instant the signal can be received with major intensity from a predetermined antenna (or from a predetermined first group of antennas) while in a following instant this signal can be received with major intensity from a second antenna (or from another predetermined second group of antennas).

Therefore mainly due to this phenomenon, it is necessary to choose time by time the antenna (or the antennas group) supplying the best signal.

Background Art

According to the known art the antenna selection appliance is able to manage an antenna switching according to two or more methods.

In particular the switching may occur based on a switching method, called "time switch diversity" or it can be based on a switching method called "instant diversity".

The switching method "time switch diversity" is based on the concept for which, in case the reception of a signal from an antenna (or antenna group) has to be considered

failed (according to a preset failure criterion), then in the next received frame a different antenna (or antenna group) is selected at the RFP (see also Fig. 2). The predetermined failure criterion may be of the proprietary type and could be based for example on the estimation of the received field strength or RSSI (Received Signal Strength Indicator) or, more generally on the estimation of the perceived signal quality.

This switching method "time switch diversity" presents the disadvantage that reaction can be slow in respect to the aforesaid fading phenomenon that should be hindered.

The already known switching method named "instant diversity" is instead realised by a fast sampler able to carry out an RSSI measurement in a short time period equal to 2-3 µs with the possibility to switch the antenna in a comparable amount of time. For example, always according to the present state of the art it is possible to sample a signal at the beginning of the slot carrying out a measurement on the antenna 1 for about 3 µs, to change the antenna in a very short time, equal to about 1 - 2 µs and then sample the received signal on the other antenna.

The "instant diversity" switching method has the advantage compared to "Time switch diversity" method that makes it possible to understand during the first 10 µs which is the best antenna and which will be selected to detect the remaining part of the signal.

However it is necessary to note that the "instant diversity" method presents certain critical aspects from the implementation point of view, because such operations are carried out at the beginning of the slot, sacrificing a few of those bits (i.e. the preamble bits) useful for the timing reconstruction and which do not bring any user data. On the other hand it cannot be carried out during the slot, because the antenna switching introduces a discontinuity in the demodulation of the slot which would make lose part of its informative content.

There has also been the proposal to use an extended preamble consisting in the repetition, at the beginning of the slot, of the preamble field in order to dedicate the first part of this field to the selection of the antenna and the second part to the specific function for which such a preamble has been foreseen by ETSI standard (like f.i. the timing reconstruction and alignment between the two communicating radio transceivers. However it is necessary to point out that if such a solution to extend preamble field makes it possible to solve the above-mentioned problems, it also defines the turning up of a further drawback consisting in the shortening of the inter slot

guard periods, which means major interference among DECT systems which are not synchronised each other (e.g. because they do not refer to the same operator) and the shortening of the propagation range.

A combination of "instant diversity" and preamble-based antenna selection technique is disclosed in the paper "Predetection quality diversity scheme for DECT outdoor applications S. Safavi and L.B. Lopes, ELECTRONICS LETTERS, vol.32, no. 11, 23 May 1996 (1996-05-23), pages 966-968, XP000599112 ISSN: 0013-5194.

This additional antenna selection technique has therefore the drawbacks above mentioned in connection with said instant diversity tecnique and in connection with said extended preamble tecnique.In the case of a system that foresees sectorial antennas it is also known to carry out the selection of antennas in such array. More precisely, at the moment when the connection on the antenna in use turns out to be degraded, a switching operation can be carried out on other antennas to see if the connection quality improved.

But such solution includes however the drawback that the choice requires to realise an RSSI measuring on a slot for each antenna of the array, and therefore it may last rather a lot of slots; too many bursts could be sacrificed because of having tried some antennas not suitable for this link. Moreover the measurements are heterogeneous with each other as they are carried out at different instants.

Furthermore it is necessary to point out that, as there is the possibility to carry out an RSSI measurement, methods have been proposed for the estimation of the speed of a mobile user which are based on the received field strength variation. Such finding is important for the handover between a DECT cell and another one of the GSM system when the mobile user moves quickly in relatively small cells.

Object of the invention

The object of the present invention is to overcome the above-mentioned problems and limitations, and in particular to propose a better method and a device for the selection of the most suitable antenna. Advantageously the method according to the invention allows also obtaining an estimation of the speed of the mobile user.

Summary of the invention

The present invention achieves these objects by means of a method with the features listed in claim 1 and by means of a device having the features listed in claim 10.

Additional features which are belived to be novel are set forth with particularity in the

appended claims.

According to the method of the invention, a series of measurements is carried out during the reception of the useful signal which does not overcome the adopted criterion to define the correlation of the slots and which will be declared as lost (so-called "SYNC FAILURE").

Now it will be illustrated the SYNC FAILURE concept. The DECT standard presents an organised frame, so that the receiver, at the moment of receiving a useful signal from one radio channel, has to:

1. reconstruct first of all the phase timings (bit and slot) from the preamble field (16 + 16 bits),
2. and then demodulate the informative content (field A and field B).

Some of these operations may fail, because of the different factors influencing the propagation such as link budget, selective fading, Doppler effect, etc.

In particular there is a key function for the detection of the transmitted signal (said "Burst") from a radio channel, which can be identified in the correlation operation. Every RFP (and, of course, every PP) is therefore provided with a correlation circuit based on criteria which can be manufactured dependant. When the found out correlation value does not overcome these criterions then the received burst is declared lost (SYNC FAILURE).

According to the previous technique no other operation will be carried out on these lost bursts except the one of counting them as such (WER calculation, Word Error Rate), taking for granted in general, that the content cannot be recovered and that the selected antenna by which they have been received, was the worst one.

Applying instead the innovative method the present invention is based on, that is executing some measurements on the received bursts having caused the sync failure, it turns out to be possible to achieve the following advantages:

· the measures are not destructive for the useful signal as they are carried out on unusable slots;

· it is possible to carry out in a very short time the measures related to the different antennas so that the selection of the most suitable antenna can be done in due time;

· measures carried out in the lost slots are more significant because they take place together with a criticality in progress that has to be improved and resolved.

Brief description of the drawings

The invention will now be described in a more detailed way with reference to a

preferred but not limiting embodiment illustrated with reference to the enclosed drawings, in which:

Fig. 1, already described, shows the network architecture of a DECT system;

Fig. 2, already described, shows the frame structure of the illustrated DECT system;

Fig. 3, already described, shows the multiframe structure of the DECT system;

Fig. 4 shows a flow chart of the antenna selection method according to the invention.

The method according to the invention foresees that in the case of missed correlation all available antennas will be scanned sequentially carrying out a certain number K of cycles.

The number K of cycles depends on the minimum duration of the measurement on each single antenna, on the minimum antenna switching time and on the number of available antennas according to the following relation:

$K = (420 * 868000 - X - Y) / (N*Ta+(N-1)*TC)$

where:

"420" is the number of bits in a time slot

"868000" is the bit time duration [μS]

"K" is the number of measurement cycles on the slot

"N" is the number of antennas

"Ta" is the measurement time [μS] on the single antenna

"Tc" is the switching time [μS] among the antennas

"X" is the inferior limit [μS] of the correlation time window

"Y" is the superior limit [μS] of the correlation time window

During said scanning period the RSSI values from the different antennas are measured, and therefore for each slot a table of the following type is collected:

CYCLE 1
ANT 1 RSSI= [ ] dBm
ANT 2 RSSI= [ ] dBm
.....
ANT N RSSI= [ ] dBm]
Ta = [ ] μs
Tc = [ ] μs

CYCLE 2
ANT 1 RSSI= [ ] dBm
ANT 2 RSSI= [ ] dBm
.....
ANT N RSSI= [ ] dBm
Ta = [ ] µs
Tc = [ ] µs
.....

CYCLE K
ANT 1 RSSI= [ ] dBm
ANT 2 RSSI= [ ] dBm
.....
ANT N RSSI= [ ] dBm
Ta = [ ] µs
Tc = [ ] µs

Referring to Fig. 4, the method foresees the following steps:

Step 1: verify if the power variability of each antenna in the period of one slot is comprised in a preset range, for example ±3 dBm.

Step 2: in the affirmative case, that is in stationary slot conditions, step 2 is started off to check if the power variability among the different antennas is comprised in a predetermined range, for example ±3 dBm.

In the negative case, according to the type of antenna(s), which has caused such result, the choice is carried out (antenna(s) selection). More precisely, it will be selected that antenna which turns out to be the best regarding the detected RSSI (i.e. which shows the major and stable RSSI value).

Step 3: In the affirmative case, always at step 2, at step 3 a counter J(J=J+1) is increased, and at

Step 4: it will be stated, if the J counter value is superior to a fixed threshold (J>Thre.?); in the negative case the table will be reconsidered, while in the positive case at

Step 5: the table of the channels will be updated, and at

Step 6: the bearer handover will be required as the diversity does not turn out to be

efficient.

If the answer to step 1 is negative, that is if the power variability of each antenna during the period of a slot is high, then at

Step 7: a counter I will be increased (I=I+1), and at

Step 8: it will be checked, if the I counter value overcomes a preset threshold (I>Tresh.?): in the negative case the table will be considered again, while in the positive case at

Step 9: the mode handover will be required to the PP, as this means that the portable set is moving with an appreciable speed compared to the dimensions of the cell and therefore defining frequent handover creates problems to the serving system. For this reason if the PP is of the dual band type, that is able either to operate according to the GSM and the DECT standard, then the PP will be forced to hand-over towards the GSM system, its speed being reasonably compatible with the operating modalities of such a system and incompatible with the operating modalities of the DECT system.

The measures correlated to the innovative method according to the present invention supply therefore the following additional information:

1) SWITCH OR INSTANT DIVERSITY

1) confirmation of the hypothesis that the used antenna is the worst (the hypothesis is based on the fact that the burst has not been received correctly).

2) Efficiency of the antenna diversity. In the case the measurements carried out on different antennas are comparable, that is contained in a range of + / - 3 dB) and still the transmitted burst is not correctly detected (i.e. it has been lost) it is preferable not to insist on the use of the diversity, but it is preferable to suggest the PP to carry out a handover.

3) The event with similar measurements could be stored as a statistic counter to value the entity of the improvement introduced by the antenna diversity.

A further advantage of this improvement consists in the fact that the extracted information is much more significant and efficient the more critical the situation of the channel and therefore the number of lost bursts are.

However nothing prohibits, in the case of finding possible anomalies, to extend these measurements outside of the lost bursts, sacrificing some correctly detected bursts or using other techniques to save the situation.

2) SELECTION IN A SECTORIAL ARRAY

During a slot it is possible to value the power received from all antennas of the array, selecting the one with the major received power.

The advantages in this case are the following:

1. the measurements are carried out in a very short time and therefore they provide homogeneous information;
2. time consuming researches by attempt are avoided on antennas which reception turns out to be of bad quality;
3. estimation of the mobile speed.

Regarding the estimation of the speed, this can happen according to two modalities.

When the duration of the slot is comparable to the duration of the fading phenomenon, the slot fading conditions can be considered as stationary for the mobile speed below 10-15 [KM] / h.

But when the duration of the slot is too short compared to the fading phenomenon, the measurement is used as a trigger for other measurements.

Although a particular embodiment of the present invention has been described, it should be understood that the present invention is not limited thereto since other embodiments may be made by those skilled in the art without departing from the scope thereof. It is thus contemplated that the present invention encompasses any and all such embodiments covered by the following claims.

CLAIMS

1. Method for the antenna selection in the fixed radio station (RFP) of a digital telecommunication system of the TDMA type, in which the signals are arranged in frames with a preset duration, and in each frame a predetermined number of time slots are assigned,

said system including a plurality of radiomobile units (PP), and said fixed radio station (RFP), which at its turn includes correlation means, i.e. means adapted to perform the correlation operation at the moment of receiving of each time slot of the frame of said digital signal and means adapted to select one antenna, or a plurality of antennas, connected to them, and in particular:

- N antennas, with $N \geq 1$, for the management in space diversity and/or polarisation of the received signal, and/or
- an array of sectorial antennas, and/or
- an array of phased antennas,

characterised in that it comprises the following operational steps:

a) verifying if the correlation operation carried out by said correlation means has been successful or not;

b) in the case of failed correlation, sequential scanning within the same time slot of all available antennas and repeatedly measuring the received field strength or RSSI for a predetermined number K of measuring cycles;

c) compiling a table containing for each antenna K measured RSSI values;

d) verifying if the power variability of each antenna during the period of a time slot is included in a first preset range;

e) in the affirmative case, verifying if the power variability between the different antennas stays in a second preset range comparing the data contained in the above-mentioned table;

f) if the verification according to the previous step e) has a negative result, starting the selection of the antenna/s applying a criterion which takes into consideration the result of the comparison according to the previous step e).

2. Method according to claim 1, characterised in that said fixed radio station (RFP] includes at least a pair of space diversity antennas and in that the criterion according to step f) consists in the choice of the antenna which received field strength value turns out to be the highest one among all measured ones.

3. Method according to claim 1, characterised in that said fixed radio station (RFP) includes at least an array of sectorial antennas, and in that the criterion according to step f) consists in the choice of the antenna, which received field strength value turns out to be the highest one among all measured ones.

4. Method according to claim 1, characterised in that, if said verification phase according to step d) does not have an affirmative result, it comprises a further step to verify if such value overcomes a first preset threshold, and if not the cycle of operations will be repeated starting from the above-mentioned step b).

5. Method according to claim 4, characterised in that, if the radiomobile unit is of the dual mode type and if said further checking step to verify if said value is higher than said first preset threshold has a positive result, also the operational modality change request of the radiomobile unit will be started off (mode handover).

6. Method according to claim 1, characterised by fact that, if said verification phase according to step e) points out an overcoming of said second preset range, a further step is foreseen to verify if the power difference among the different antennas overcomes a second preset threshold, and in the negative case, the cycle of operations will be repeated starting from the above-mentioned step b).

7. Method according to claim 6, characterised in that, if said further step to verify if the difference of power among the different antennas overcomes a second preset threshold has a positive result, then also the request to change the bearer in use will be started off (bearer handover).

8. Method according to claim 1, characterised in that said number K of measuring cycles is calculated according to the following formula:

$K = (420 * 868000 - X - Y) / (N*Ta+(N-1)*TC)$

where:

- "420" is the number of bits in a time slot;
- "868000" is the bit time duration [μS];
- "N" is the number of antennas;
- "Ta" is the measurement time [μS] on the single antenna;
- "Tc" is the switching time [μS] among the antennas;
- "X" is the inferior limit [μS] of the correlation time window;
- "Y" is the superior limit [μS] of the correlation time window.

9. Method according to the previous claims, characterised in that said first and second preset ranges are equal to ± 3 dBm.

10. Device for the antenna selection in the fixed radio station (RFP) of a digital telecommunication system of the TDMA type, in which the signals are arranged in frames with a predetermined duration, and in each frame a predetermined number of time slots will be assigned, said system including a plurality of radiomobile units (PP) and said fixed station (RFP) which at its turn includes means adapted to carry out the correlation operation at the moment of receiving each time slot of the frame of said digital signal and means for the selection of one antenna or of a plurality of antennas to which are connected:

- N antennas for the management in space diversity and/or polarisation of the received signal, and/or
- an array of sectorial antennas, and/or
- a phased array of antennas,

characterised in that it operates according to the method disclosed in claim 1.

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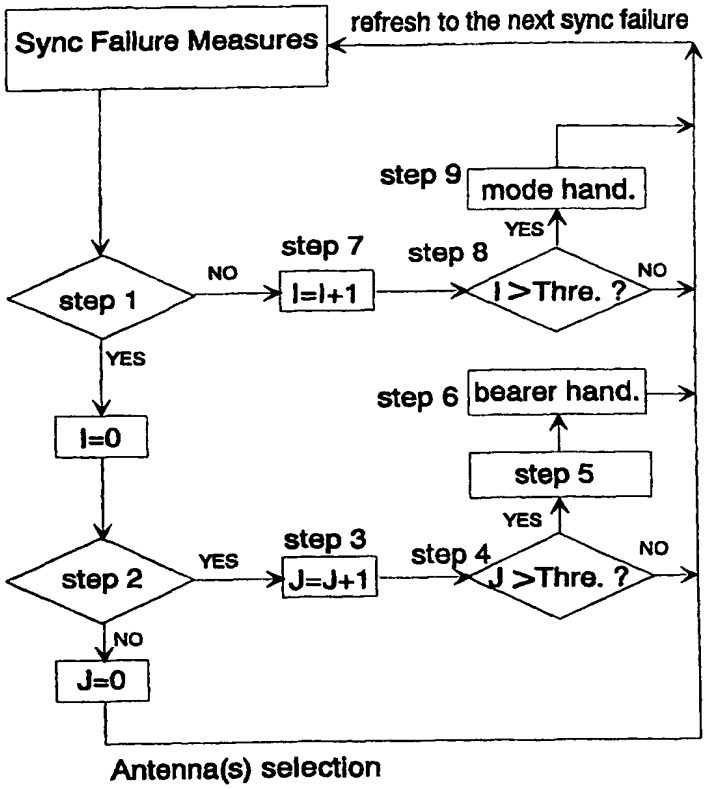
(54) Title: METHOD AND DEVICE FOR THE ANTENNA SELECTION IN A DIGITAL TELECOMMUNICATION SYSTEM

(57) Abstract

Method for antenna selection in the fixed radio station (RFP) of a TDMA digital telecommunication system set up by a plurality of radiomobile units (PP) and said fixed radio station (RFP) which at its turn includes means adapted to carry out the correlation operation at the moment of receiving each time slot of the frame of said digital signal and means for the selection on one antenna or of a plurality of antennas to which are connected. The method including the steps of: a) verifying if the correlation operation carried out has been successful; b) in the case of missed correlation, scanning in sequences of all available antennas and measuring the received field strength or RSSI; c) compiling of a table containing for each antenna the measured RSSI value; d) verifying if the power variability of the detected signal at each antenna within the time slot period stays in a prefixed range; e) in the affirmative case, verifying if the power variability among the different antennas stays in a second prefixed range comparing the data contained in the aforesaid table; f) if verification of previous step has a negative result, starting the selection of the antenna/s and using a criterion that takes into account the result of comparison mentioned in the previous step.



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"Method and Device for the Antenna Selection in a Digital Telecommunication System»

Technical Field

The present invention relates to digital telecommunication systems according to Time Division Multiple Access (TDMA), and in particular, but not exclusively, relates to systems operating according the DECT standard (Digital Enhanced Cordless Telecommunications).

More precisely, the present invention relates to a method and a device for the selection of an antenna used in the fixed radio station of such system.

In the following description reference will be made in particular to a DECT system, without that this should be limited thereto. The invention can be generally applied in systems where the connection between two transceiver units (a radiomobile or portable unit or PP (Portable Part according to the DECT terminology) and a fixed radio station or RFP (Radio Fixed Part) is realized.

As already known, the DECT system includes a plurality of fixed radio stations distributed in a way to cover the interested areas and controlled by a centralised unit (CCFP, Central Control Fixed Part), and connected to a switching network which may be the public one of the private type (PABX), and of portable units linking up via radio with the fixed radio stations, and being able to communicate with each other and with others fixed users connected to the telephone network. The links may be of the voice type or they may enable the exchange of data occupying the equivalent of one or more voice "channels".

At first, an exemplary DECT network architecture is schematically illustrated in Fig. 1.

It comprises groupings of h (in the example of the figure h = 4) fixed radio stations RFP (Radio Fixed Part) preferably connected to coppers (in the example 3 coppers) set up by connection or dorsal lines L through drop/insert devices DI. Without departing from the scope of the present invention, it turns obviously out to be possible to connect in a star-shaped way each RFP to the CCFP eliminating the aforesaid connection lines, and therefore obviously also the Drop/Insert devices DI.

Each RFP can manage via radio a certain number of PPs, which generally are mobile.

The coppers end up at a TRAnScoder unit TRAS, and the latter is for example connected to the public network PSTN (Public Switching Telephone Network) through a Central Control Fixed Part (CCFP) associated to a switching network or a dedicaded switching module MEP.

Regarding the vocal signals, digital 64 Kbit/s channels typically set up the interface between the CCFP and the accessed network. To the CCFP unit a set of transcoders TRAS is associated providing for the conversion of the PCM codification (Pulse Code Modulation) on 8 bits used at the PSTN side into an ADPCM (Adaptive Differential Pulse Code Modulation) codification on four bits used at the DECT side. In this way two 32 Kbit/s channels can be mapped onto each 64 Kbit/s channel.

The 2,048 Mbit/s (bi-directional) connection link connecting the CCFP to the different RFPs supports therefore 48 voice channels plus a predetermined number of synchronisation and signalling channels.

The area covered by a fixed radio station or cell is generally rather reduced, arriving also to a radio coverage radius of tens or hundreds of metres. Typical applications of the personal telephony systems can be found in industrial plants where they may substitute the installation of a cabled network, in shopping centres or urban centres where they may advantageously substitute public telephone boxes and so on.

The telecommunication network for personal telephony is of the digital type. The radio access technology is of the type FDMA (Frequency Division Multiple Access) - TDMA (Time Division Multiple Access) - TDD (Time Division Duplex).

The system is of the TDD type as the transmission and reception direction are time divided. More precisely, as illustrated with reference to Fig. 2, the time frame interval of 10 milliseconds is divided into two halves: usually during the first 5 ms (i.e. in the first half frame) the fixed radio station transmits and the portables receive, and in the following 5 ms (i.e. in the second half frame) the contrary happens. Each half frame is set up by 12 time channels or time slots, hereafter for the sake of brevity also referred to as "slot", (from which it comes that DECT is a TDMA system, set up by 420 (or in some cases by 424) bits. The slots are transmitted or received using 10 (or more) different frequencies (from where it results that DECT is an FDMA system as well, which allows to provide to the system up to 120 (or more) radio channels (where a radio channel is identified by the pair (time slot + frequency).

The DECT multiframe is illustrated in Fig.3 and has a duration of 160 ms. so that it includes 16 frames of 10 msec each as described in Fig. 2

For further details on the DECT system please refer to the specifications established by the European Telecommunications Standards Institute, briefly ETSI (Ref. EN 300 175 specification).

In a DECT system the fixed radio station or RFP has an antenna system which may have different configurations:

- N antennas (with N equal to at least 2) for management in space diversity and/or polarisation of the received signal;
- a set of sectorial antennas, that is a system in which a plurality of antennas is connected to each RFP where every antenna of the set lightens just a portion (or sector) of the entire cell or of the RFP coverage area (usually trisection antennas are defined which implies therefore the use of antennas with a coverage angle of 120°);
- a set of phased antennas suitable to set up a radiation diagram with variable direction and gain.

Moreover the RFP includes a selection device or appliance among the antennas enabling the selection of the most suitable one that is that antenna which assures the better quality for the detected signal.

In fact the transmitted signal, especially in an urban environment, may be affected by the so-called fading phenomenon constituted by amplitude and phase variations of the electromagnetic field or of the power of the detected signal due to changeable propagation conditions. Because of such a phenomenon, in a predetermined instant the signal can be received with major intensity from a predetermined antenna (or from a predetermined first group of antennas) while in a following instant this signal can be received with major intensity from a second antenna (or from another predetermined second group of antennas).

Therefore mainly due to this phenomenon, it is necessary to choose time by time the antenna (or the antennas group) supplying the best signal.

Background Art

According to the known art the antenna selection appliance is able to manage an antenna switching according to two or more methods.

In particular the switching may occur based on a switching method, called "time switch diversity" or it can be based on a switching method called "instant diversity".

The switching method "time switch diversity" is based on the concept for which, in case the reception of a signal from an antenna (or antenna group) has to be considered

failed (according to a preset failure criterion), then in the next received frame a different antenna (or antenna group) is selected at the RFP (see also Fig. 2). The predetermined failure criterion may be of the proprietary type and could be based for example on the estimation of the received field strength or RSSI (Received Signal Strength Indicator) or, more generally on the estimation of the perceived signal quality.

This switching method "time switch diversity" presents the disadvantage that reaction can be slow in respect to the aforesaid fading phenomenon that should be hindered.

The already known switching method named "instant diversity" is instead realised by a fast sampler able to carry out an RSSI measurement in a short time period equal to 2-3 μs with the possibility to switch the antenna in a comparable amount of time. For example, always according to the present state of the art it is possible to sample a signal at the beginning of the slot carrying out a measurement on the antenna 1 for about 3 μs, to change the antenna in a very short time, equal to about 1 - 2 μs and then sample the received signal on the other antenna.

The «instant diversity» switching method has the advantage compared to «Time switch diversity» method that makes it possible to understand during the first 10 μs which is the best antenna and which will be selected to detect the remaining part of the signal.

However it is necessary to note that the «instant diversity» method presents certain critical aspects from the implementation point of view, because such operations are carried out at the beginning of the slot, sacrificing a few of those bits (i.e. the preamble bits) useful for the timing reconstruction and which do not bring any user data. On the other hand it cannot be carried out during the slot, because the antenna switching introduces a discontinuity in the demodulation of the slot which would make lose part of its informative content.

There has also been the proposal to use an extended preamble consisting in the repetition, at the beginning of the slot, of the preamble field in order to dedicate the first part of this field to the selection of the antenna and the second part to the specific function for which such a preamble has been foreseen by ETSI standard (like f.i. the timing reconstruction and alignment between the two communicating radio transceivers. However it is necessary to point out that if such a solution to extend preamble field makes it possible to solve the above-mentioned problems, it also defines the turning up of a further drawback consisting in the shortening of the inter slot

guard periods, which means major interference among DECT systems which are not synchronised each other (e.g. because they do not refer to the same operator) and the shortening of the propagation range.

In the case of a system that foresees sectorial antennas it is also known to carry out the selection of antennas in such array. More precisely, at the moment when the connection on the antenna in use turns out to be degraded, a switching operation can be carried out on other antennas to see if the connection quality improved.

But such solution includes however the drawback that the choice requires to realise an RSSI measuring on a slot for each antenna of the array, and therefore it may last rather a lot of slots; too many bursts could be sacrificed because of having tried some antennas not suitable for this link. Moreover the measurements are heterogeneous with each other as they are carried out at different instants.

Furthermore it is necessary to point out that, as there is the possibility to carry out an RSSI measurement, methods have been proposed for the estimation of the speed of a mobile user which are based on the received field strength variation. Such finding is important for the handover between a DECT cell and another one of the GSM system when the mobile user moves quickly in relatively small cells.

Object of the invention

The object of the present invention is to overcome the above-mentioned problems and limitations, and in particular to propose a better method and a device for the selection of the most suitable antenna. Advantageously the method according to the invention allows also obtaining an estimation of the speed of the mobile user.

Summary of the invention

The present invention achieves these objects by means of a method with the features listed in claim 1 and by means of a device having the features listed in claim 10.

Additional features which are belived to be novel are set forth with particularity in the appended claims.

According to the method of the invention, a series of measurements is carried out during the reception of the useful signal which does not overcome the adopted criterion to define the correlation of the slots and which will be declared as lost (so-called «SYNC FAILURE»).

Now it will be illustrated the SYNC FAILURE concept. The DECT standard presents an organised frame, so that the receiver, at the moment of receiving a useful signal

from one radio channel, has to:

1 reconstruct first of all the phase timings (bit and slot) from the preamble field (16 + 16 bits),

2 and then demodulate the informative content (field A and field B).

Some of these operations may fail, because of the different factors influencing the propagation such as link budget, selective fading, Doppler effect, etc.

In particular there is a key function for the detection of the transmitted signal (said «Burst») from a radio channel, which can be identified in the correlation operation. Every RFP (and, of course, every PP) is therefore provided with a correlation circuit based on criteria which can be manufactured dependant. When the found out correlation value does not overcome these criterions then the received burst is declared lost (SYNC FAILURE).

According to the previous technique no other operation will be carried out on these lost bursts except the one of counting them as such (WER calculation, Word Error Rate), taking for granted in general, that the content cannot be recovered and that the selected antenna by which they have been received, was the worst one.

Applying instead the innovative method the present invention is based on, that is executing some measurements on the received bursts having caused the sync failure, it turns out to be possible to achieve the following advantages:

· the measures are not destructive for the useful signal as they are carried out on unusable slots;

· it is possible to carry out in a very short time the measures related to the different antennas so that the selection of the most suitable antenna can be done in due time;

· measures carried out in the lost slots are more significant because they take place together with a criticality in progress that has to be improved and resolved.

Brief description of the drawings

The invention will now be described in a more detailed way with reference to a preferred but not limiting embodiment illustrated with reference to the enclosed drawings, in which:

Fig. 1, already described, shows the network architecture of a DECT system;

Fig. 2, already described, shows the frame structure of the illustrated DECT system;

Fig. 3, already described, shows the multiframe structure of the DECT system;

Fig. 4 shows a flow chart of the antenna selection method according to the

invention.

The method according to the invention foresees that in the case of missed correlation all available antennas will be scanned sequentially carrying out a certain number K of cycles.

The number K of cycles depends on the minimum duration of the measurement on each single antenna, on the minimum antenna switching time and on the number of available antennas according to the following relation:

$K = (420 * 868000 - X - Y) / (N*Ta+(N-1)*TC)$

where:

«420» is the number of bits in a time slot

«868000» is the bit time duration [μS]

«K» is the number of measurement cycles on the slot

«N» is the number of antennas

«Ta» is the measurement time [μS] on the single antenna

«Tc» is the switching time [μS] among the antennas

«X» is the inferior limit [μS] of the correlation time window

«Y» is the superior limit [μS] of the correlation time window

During said scanning period the RSSI values from the different antennas are measured, and therefore for each slot a table of the following type is collected:

CYCLE 1

ANT 1 RSSI= [ ] dBm

ANT 2 RSSI= [ ] dBm

.....

ANT N RSSI= [ ] dBm]

Ta = [ ] μs

Tc = [ ] μs

CYCLE 2

ANT 1 RSSI= [ ] dBm

ANT 2 RSSI= [ ] dBm

.....

ANT N RSSI= [ ] dBm

Ta = [ ] μs

Tc = [ ] μs

.....

CYCLE K

ANT 1 RSSI= [ ] dBm

ANT 2 RSSI= [ ] dBm

.....

ANT N RSSI= [ ] dBm

Ta = [ ] μs

Tc = [ ] μs

Referring to Fig. 4, the method foresees the following steps:

Step 1: verify if the power variability of each antenna in the period of one slot is comprised in a preset range, for example ±3 dBm.

Step 2: in the affirmative case, that is in stationary slot conditions, step 2 is started off to check if the power variability among the different antennas is comprised in a predetermined range, for example ±3 dBm.

In the negative case, according to the type of antenna(s), which has caused such result, the choice is carried out (antenna(s) selection). More precisely, it will be selected that antenna which turns out to be the best regarding the detected RSSI (i.e. which shows the major and stable RSSI value).

Step 3: In the affirmative case, always at step 2, at step 3 a counter J(J=J+1) is increased, and at

Step 4: it will be stated, if the J counter value is superior to a fixed threshold (J>Thre.?); in the negative case the table will be reconsidered, while in the positive case at

Step 5: the table of the channels will be updated, and at

Step 6: the bearer handover will be required as the diversity does not turn out to be efficient.

If the answer to step 1 is negative, that is if the power variability of each antenna during the period of a slot is high, then at

Step 7: a counter I will be increased (I=I+1), and at

Step 8: it will be checked, if the I counter value overcomes a preset threshold (I>Tresh.?): in the negative case the table will be considered again, while in the positive case at

Step 9: the mode handover will be required to the PP, as this means that the portable set is moving with an appreciable speed compared to the dimensions of the cell and therefore defining frequent handover creates problems to the serving system. For this reason if the PP is of the dual band type, that is able either to operate according to the GSM and the DECT standard, then the PP will be forced to hand-over towards the GSM system, its speed being reasonably compatible with the operating modalities of such a system and incompatible with the operating modalities of the DECT system.

The measures correlated to the innovative method according to the present invention supply therefore the following additional information:

1) SWITCH OR INSTANT DIVERSITY

1) confirmation of the hypothesis that the used antenna is the worst (the hypothesis is based on the fact that the burst has not been received correctly).

2) Efficiency of the antenna diversity. In the case the measurements carried out on different antennas are comparable, that is contained in a range of + / - 3 dB) and still the transmitted burst is not correctly detected (i.e. it has been lost) it is preferable not to insist on the use of the diversity, but it is preferable to suggest the PP to carry out a handover.

3) The event with similar measurements could be stored as a statistic counter to value the entity of the improvement introduced by the antenna diversity.

A further advantage of this improvement consists in the fact that the extracted information is much more significant and efficient the more critical the situation of the channel and therefore the number of lost bursts are.

However nothing prohibits, in the case of finding possible anomalies, to extend these measurements outside of the lost bursts, sacrificing some correctly detected bursts or using other techniques to save the situation.

2) SELECTION IN A SECTORIAL ARRAY

During a slot it is possible to value the power received from all antennas of the array, selecting the one with the major received power.

The advantages in this case are the following:

1 the measurements are carried out in a very short time and therefore they provide homogeneous information;

2 time consuming researches by attempt are avoided on antennas which reception turns out to be of bad quality;

3 estimation of the mobile speed.

Regarding the estimation of the speed, this can happen according to two modalities.

When the duration of the slot is comparable to the duration of the fading phenomenon, the slot fading conditions can be considered as stationary for the mobile speed below 10-15 [KM] / h.

But when the duration of the slot is too short compared to the fading phenomenon, the measurement is used as a trigger for other measurements.

Although a particular embodiment of the present invention has been described, it should be understood that the present invention is not limited thereto since other embodiments may be made by those skilled in the art without departing from the scope thereof. It is thus contemplated that the present invention encompasses any and all such embodiments covered by the following claims.

CLAIMS

1. Method for the antenna selection in the fixed radio station (RFP) of a digital telecommunication system of the TDMA type, in which the signals are arranged in frames with a preset duration, and in each frame a predetermined number of time slots are assigned,

said system including a plurality of radiomobile units (PP), and said fixed radio station (RFP), which at its turn includes correlation mens, i.e. means adapted to perform the correlation operation at the moment of receiving of each time slot of the frame of said digital signal and mans adapted to select one antenna, or a plurality of antennas, connected to them, and in particular:

- N antennas, with $N \geq 1$, for the management in space diversity and/or polarisation of the received signal, and/or
- an array of sectorial antennas, and/or
- an array of phased antennas,

characterised in that it foresees the following operational steps:

a) verifying if the correlation operation carried out by said correlation means has been successful or not;

b) in the case of failed correlation, sequential scanning within the same time slot of all available antennas and measuring the received field strength or RSSI;

c) compiling a table containing for each antenna the measured RSSI value;

d) verifying if the power variability of each antenna during the period of a time slot is included in a first preset range;

e) in the affirmative case, verifying if the power variability between the different antennas stays in a second preset range comparing the data contained in the above-mentioned table;

f) if the verification according to the previous step e) has a negative result, starting the selection of the antenna/s applying a criterion which takes into consideration the result of the comparison according to the previous step e).

2. Method according to claim 1, characterised in that said fixed radio station (RFP] includes at least a pair of space diversity antennas and in that the criterion according to step f) consists in the choice of the antenna which received field strength value turns out to be the highest one among all measured ones.

3. Method according to claim 1. characterised in that said fixed radio station

(RFP) includes at least an array of sectorial antennas, and in that the criterion according to step f) consists in the choice of the antenna, which received field strength value turns out to be the highest one among all measured ones.

4. Method according to claim 1, characterised in that, if said verification phase according to step d) does not have an affirmative result, it foresees a further step to verify if such value overcomes a first preset threshold, and if not the cycle of operations will be repeated starting from the above-mentioned step b).

5. Method according to claim 4, characterised in that, if the radiomobile unit is of the dual mode type and if said further checking step to verify if said value is higher than said first preset threshold has a positive result, also the operational modality change request of the radiomobile unit will be started off (mode handover).

6. Method according to claim 1, characterised by fact that, if said verification phase according to step e) points out an overcoming of said second preset range, a further step is foreseen to verify if the power difference among the different antennas overcomes a second preset threshold, and in the negative case, the cycle of operations will be repeated starting from the above-mentioned step b).

7. Method according to claim 6, characterised in that, if said further step to verify if the difference of power among the different antennas overcomes a second preset threshold has a positive result, then also the request to change the bearer in use will be started off (bearer handover).

8. Method according to claim 1, characterised in that in said step b) a predetermined number K of measuring cycles will be carried out, K being equal to:

$K = (420 * 868000 - X - Y) / (N*Ta+(N-1)*TC)$

where:

- «420» is the number of bits in a time slot;
- «868000» is the bit time duration [μS];
- «N» is the number of antennas;
- «Ta» is the measurement time [μS] on the single antenna;
- «Tc» is the switching time [μS] among the antennas;
- «X» is the inferior limit [μS] of the correlation time window;
- «Y» is the superior limit [μS] of the correlation time window.

9. Method according to the previous claims, characterised in that said first and second preset ranges are equal to ± 3 dBm.

10. Device for the antenna selection in the fixed radio station (RFP) of a digital

telecommunication system of the TDMA type, in which the signals are arranged in frames with a predetermined duration, and in each frame a predetermined number of time slots will be assigned. said system including a plurality of radiomobile units (PP) and said fixed station (RFP) which at its turn includes means adapted to carry out the correlation operation at the moment of receiving each time slot of the frame of said digital signal and means for the selection of one antenna or of a plurality of antennas to which are connected:

- N antennas for the management in space diversity and/or polarisation of the received signal, and/or
- an array of sectorial antennas, and/or
- a phased array of antennas,

characterised in that it operates according to the method disclosed in claim 1.

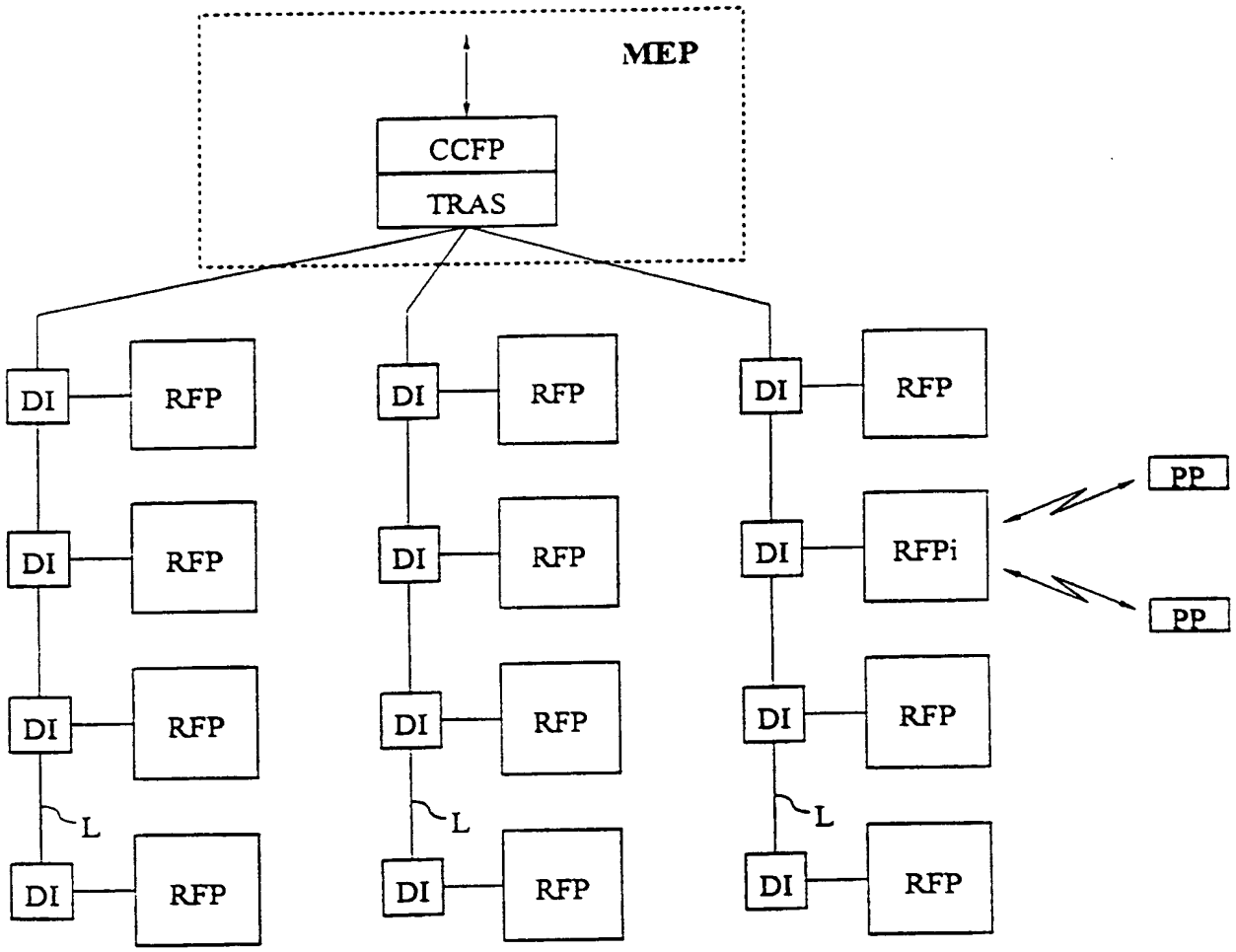

Fig. 1

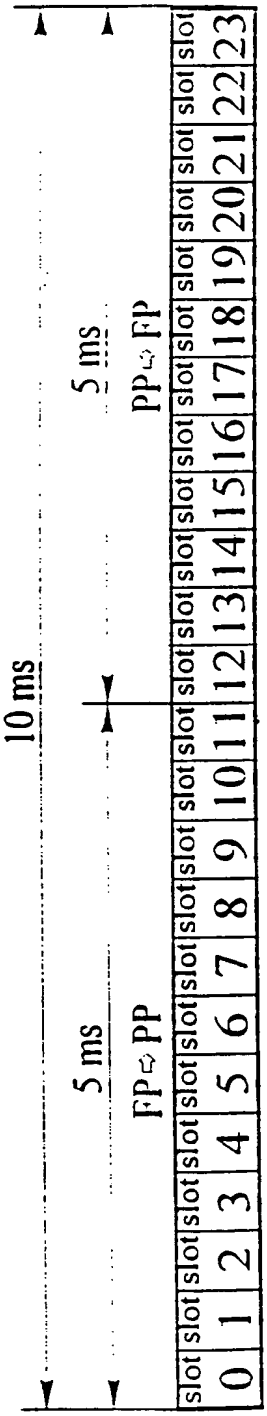
10 ms
5 ms
5 ms
FP ⇨ PP
PP ⇨ FP
slot 0
slot 1
slot 2
slot 3
slot 4
slot 5
slot 6
slot 7
slot 8
slot 9
slot 10
slot 11
slot 12
slot 13
slot 14
slot 15
slot 16
slot 17
slot 18
slot 19
slot 20
slot 21
slot 22
slot 23

Fig. 2

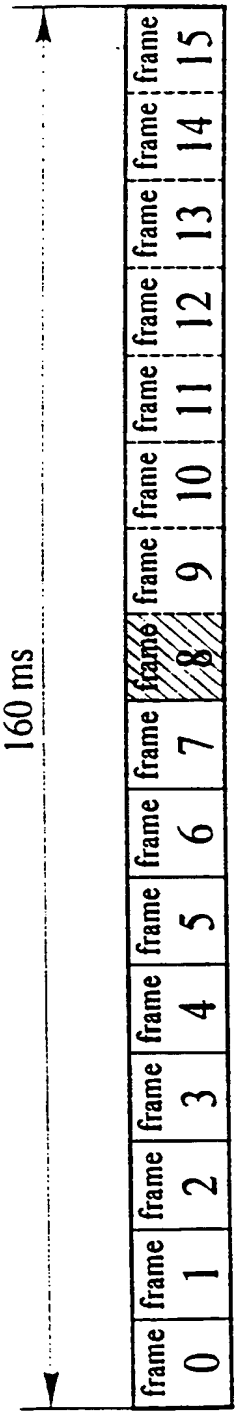
160 ms
frame 0
frame 1
frame 2
frame 3
frame 4
frame 5
frame 6
frame 7
frame 8
frame 9
frame 10
frame 11
frame 12
frame 13
frame 14
frame 15

Fig. 3

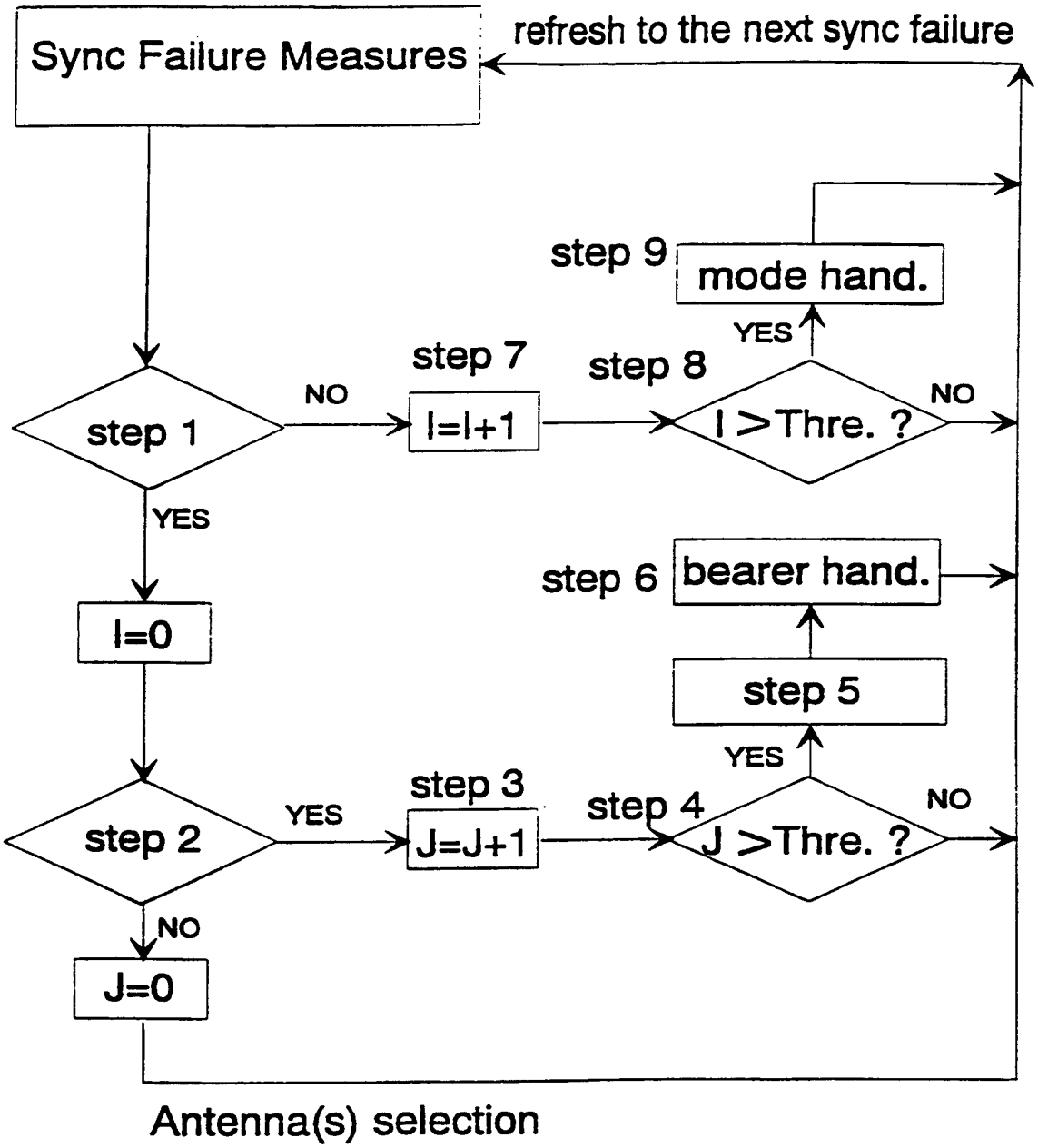
Sync Failure Measures
refresh to the next sync failure
step 9
mode hand.
YES
step 7
step 8
step 1
NO
I=I+1
I >Thre. ?
NO
YES
step 6
bearer hand.
I=0
step 5
YES
step 3
step 4
step 2
YES
J=J+1
J >Thre. ?
NO
NO
J=0
Antenna(s) selection

Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 99/05326

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B7/08 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 08089 A (NOKIA TELECOMMUNICATIONS OY ;MOGENSEN PREBEN (DK)) 14 March 1996 (1996-03-14) page 3, line 11 -page 4, line 4 page 5, line 1 - line 3 page 5, line 21 - line 27 page 6, line 14 - line 25 ---	1,10
A	US 5 459 873 A (MOORE MORRIS ET AL) 17 October 1995 (1995-10-17) column 2, line 24 - line 26 column 2, line 36 - line 39 column 3, line 44 - line 56 column 4, line 12 - line 21 claims 1-3 claim 6 figure 4 --- -/--	1,10

[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
4 November 1999	18/11/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Gkeli, M

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INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/EP 99/05326

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SAFAVI S ET AL: "PREDETECTION QUALITY DIVERSITY SCHEME FOR DECT OUTDOOR APPLICATIONS" ELECTRONICS LETTERS, vol. 32, no. 11, 23 May 1996 (1996-05-23), pages 966-968, XP000599112 ISSN: 0013-5194 page 967, left-hand column, line 1 - line 5 page 967, left-hand column, line 27 - line 41 page 967, right-hand column, line 11 -page 968, left-hand column, line 4 figure 1 -----	1,10

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INTERNATIONAL SEARCH REPORT

ormation on patent family members

International Application No
PCT, _P 99/05326

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9608089 A	14-03-1996	AU 3347495 A	27-03-1996
US 5459873 A	17-10-1995	NONE	